Metric Single tree Total Volume Tables for the Yukon Territory

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METRIC SINGLE-TREE TOTAL VOLUME TABLES FOR THE YUKON TERRITORY

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ABSTRACT

Metric single-tree volume tables are presented for the four major tree species in the Yukon Territory. Total inside-bark stem volume is shown as a function of total height and outside-bark diameter breast height.

RESUME

Des tables de volume en métrique pour un seul arbre sont présentées pour les quatre espèces importantes du territoire du Yukon. Le volume totale des tiges (sans écorces) est fonction de la hauteur totale de l'arbre et du diamètre a hauteur d'homme incluant l'écorce.

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INTRODUCTION

A study of tree component weights conducted by Nawitka Renewable Resource Consultants and funded by the Canadian Forestry Service destructively sampled 362 white spruce (*Picea glauca* (Moench) Voss), 300 black spruce (*Picea mariana* (Mill.) B.S.P.), 148 lodgepole pine (*Pinus contorta* Dougl.) and 175 trembling aspen (*Populus tremuloides* Michx.) in the Yukon between 1980 and 1982. These samples were randomly distributed across the accessible areas of ecoregions 1, 2, 4, 5, 8, 9, 11 and 12 (Oswald and Senyk 1977) on the basis of species representation (Gairns 1968). The exception was ecoregion 1, where only white spruce was sampled. Sample distribution is shown in Appendix A; ecoregion location is shown in Appendix B.

Sectioning of the sample trees during the biomass measurement allowed the calculation of whole tree volumes by Smalian's formula. Utilization of the accompanying field measurements permitted the development of equations to predict the volume for white spruce, lodgepole pine, black spruce and trembling aspen in each ecoregion.

METHODS

For each species the following procedure was used:

1. Height-diameter regressions were fitted to the sample trees in each ecoregion. Sample trees in each ecoregion were examined for seriously atypical trees by examination of scatter diagrams that related height to diameter. Three trees were rejected as being seriously atypical. Inspection of the height-diameter curves determined an initial grouping of ecoregions. Using these groupings, volume equations of the type $V = aDBH^bHt^c$ were fitted using least squares regression. The groupings were subjected to covariance analysis to determine whether they represented an improvement over a single equation for the Yukon for each species. In all cases the result was significant at the 99% level. Statistics may be found in Appendix C.

2. Metric volume tables were constructed for each grouping by means of the derived logarithmic equation.

3. The statistical hypothesis of a single volume equation for mixed and pure stands was tested and shown to be valid.

RESULTS

The metric volume tables that follow show the total volume of the stem, inside bark, from germination to terminal bud. The diameter shown is standing DBH measured at 1.3 metres. Height is total height. There is no allowance for defect.

References

Gairns, C.H. 1968. The Yukon Economy—Its Potential for Growth and Continuity: Volume VIII—References Study on Forest Resources. D. Wm. Carr & Associates for Dept. of Indian Affairs and Northern Development and the Government of Yukon Territory, Ottawa.

Oswald, E.T. and J.P. Senyk. 1977. Ecoregions of Yukon Territory. Can. For. Serv., Pac. For. Res. Cent., Inf. Rep. BC-X-164.

Table 1. Cubic metre volume table for white spruce (all ages), Yukon Territory, Ecoregions 1, 2, 9, 11, and 12.

DBH (cm)	Height (m)																	Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	
4			.0051	.0065															19
6				.0134	.0164	.0195													12
8	.0081				.0274	.0325	.0377												24
10	.0120						.0560	.0638											16
12	.0166	.0261	.0359					.0882	.0991										24
14		.0343	.0471	.0604				.1159	.1303	.1449									21
16			.0597	.0765						.1836	.2022								16
18			.0736	.0943							.2493	.2724	.2958						18
20			.0888	.1137							.3005	.3284	.3566	.3850					11
22				.1347										.4559	.4398				10
24				.1572	.1925	.2284								.5321	.5716				13
26					.2219	.2633								.6134	.6589				6
28					.2531	.3003									.7515	.8039			10
30					.2860	.3394									.8495	.9086			7
32						.3806	.4414	.5030								1.019	1.086		10
34							.4916	.5602	.6297							1.135	1.209		8
36									.6969	.7747						1.256	1.338		3
38									.7671	.8527							1.473	1.564	4
40									.8403	.9340							1.613	1.713	4
42									.9163	1.019								1.868	3
44										1.106									2
46										1.197	1.318								2
48											1.422	1.554	1.687	1.821					0
50												1.671	1.814	1.958					0
52													1.945	2.100					1
54														2.245	2.412	2.580			1
56															2.573	2.752	2.932		1
58																	3.120	3.313	0
																			246

Note: Shading indicates range of data.

Data collected by destructive sampling of 246 trees in accessible locations of the Yukon.
Table shows total volume of the stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes were obtained by means of a logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000433 \; D^{1.77531} \; H^{1.10980}$
Standard error of estimate = .1420.
Coefficient of determination (R^2) = .994.

Table 2. Cubic metre volume table for white spruce (all ages), Yukon Territory, Ecoregions 4, 5, and 8.

DBH (cm)	Height (m)														Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	
4			.0050	.0064											8
6				.0132	.0162										11
8	.0079			.0221	.0270	.0321									9
10	.0118				.0402	.0478	.0554								6
12	.0163						.0766	.0874							11
14	.0214	.0337					.1008	.1150							14
16		.0427						.1457	.1639						14
18		.0526	.0726					.1796	.2021						12
20			.0875	.1123					.2437	.2711					5
22				.1330					.2886	.3211					4
24				.1553	.1904	.2261				.3747	.4130				2
26					.2194	.2607					.4761	.5207			5
28					.2503	.2974					.5431	.5939			4
30					.2830	.3362					.6139	.6714			1
32					.3173	.3770					.6885	.7529			6
34						.4198	.4874				.7668	.8385			0
36							.5395					.9281	1.008		2
38							.5939	.6774	.7621			1.022	1.110		0
40								.7420	.8347				1.216	1.313	2
42									.9103	1.013	1.116	1.220	1.326	1.432	0
															116

Note: Shading indicates range of data.

Data collected by destructive sampling of 116 trees in accessible locations of the Yukon.
Table shows total volume of entire stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000419 \; D^{1.77630} \; H^{1.11743}$
Standard error of estimate = .0983.
Coefficient of determination (R^2) = .996.

Table 3. Cubic metre volume table for black spruce (all ages), Yukon Territory, Ecoregions 2, 5, 11, and 12.

DBH (cm)	Height (m)											Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	
4		.0037	.0050									16
6			.0105	.0133								16
8	.0084			.0225	.0273	.0322						16
10	.0126	.0195			.0410	.0484	.0559					19
12	.0176	.0272					.0779	.0884				19
14		.0360						.1171	.1311			24
16		.0459	.0626					.1493	.1672	.1852		17
18		.0569	.0775							.2296	.2520	19
20		.0690	.0940							.2782	.3054	8
22			.1118	.1420						.3310	.3634	9
24			.1310	.1664						.3879	.4258	5
26				.1926	.2342	.2763				.4488	.4927	4
28					.2681	.3163	.3650			.5137	.5640	1
30							.4139	.4697	.5259	.5826		0
32								.5283	.5916			0
												173

Note: Shading indicates range of data.

Data collected by destructive sampling of 173 trees in accessible locations of the Yukon.
Table shows total volume of the stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000429\ D^{1.82290}\ H^{1.07309}$
Standard error of estimate = .0972.
Coefficient of determination (R^2) = .996.

Table 4. Cubic metre volume table for black spruce (all ages), Yukon Territory, Ecoregions 4, 8, and 9.

DBH (cm)	Height (m)											Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	
4		.0036	.0048	.0060								8
6			.0103	.0129								7
8				.0221	.0265							13
10	.0135			.0337	.0404	.0470	.0537					13
12	.0190				.0568	.0662	.0757	.0851				25
14	.0254	.0381						.1136	.1262			23
16	.0327	.0489						.1460	.1621			10
18		.0610						.1821	.2022			8
20		.0743	.0990					.2219	.2464			7
22			.1184						.2947	.3240		3
24			.1394						.3469	.3815		6
26			.1620	.2023	.2425				.4032	.4433		2
28				.2324	.2787	.3249	.3711		.4633	.5094		2
30						.3698	.4224	.4749	.5274			0
32								.5360				0
												127

Note: Shading indicates range of data.

Data collected by destructive sampling of 127 trees in accessible locations of the Yukon.
Table shows total volume of entire stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000452\ D^{1.87679}\ H^{0.99520}$
Standard error of estimate = .1059.
Coefficient of determination (R^2) = .993.

Table 5. Cubic metre volume table for lodgepole pine (all ages), Yukon Territory, Ecoregions 2 and 5.

DBH (cm)	Height (m)												Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	26	
4	.0026	.0040	.0052	.0064	.0076								9
6	.0061	.0088	.0115	.0141	.0167	.0193							8
8	.0107	.0155	.0202	.0248	.0293	.0338	.0382						13
10	.0165	.0240	.0312	.0383	.0453	.0522	.0590	.0658					11
12	.0236	.0342	.0445	.0547	.0647	.0745	.0842	.0939	.1034				14
14		.0462	.0602	.0739	.0874	.1007	.1138	.1268	.1397	.1525			5
16			.0781	.0959	.1134	.1306	.1477	.1646	.1813	.1979	.2144		14
18				.1207	.1427	.1644	.1859	.2072	.2282	.2491	.2699	.2905	10
20				.1482	.1753	.2020	.2284	.2545	.2803	.3060	.3315	.3568	4
22				.1786	.2111	.2433	.2751	.3066	.3377	.3686	.3993	.4298	2
24				.2116	.2502	.2883	.3260	.3633	.4002	.4369	.4732	.5094	1
26				.2474	.2926	.3371	.3811	.4247	.4679	.5108	.5533	.5955	1
28				.2859	.3381	.3896	.4405	.4908	.5408	.5903	.6394	.6882	2
30					.3869	.4458	.5040	.5616	.6187	.6754	.7316	.7875	1
32						.5056	.5717	.6370	.7018	.7661	.8299	.8932	1
34							.6435	.7171	.7900	.8623	.9341	1.005	1
36								.8017	.8833	.9641	1.044		0
38										1.071			0
													97

Note: Shading indicates range of data.

Data collected by destructive sampling of 97 trees in accessible locations of the Yukon.
Table shows total volume of the stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: Volume = $.0000515\ D^{1.95239}\ H^{0.91923}$
Standard error of estimate = .1232.
Coefficient of determination (R^2) = .993.

Table 6. Cubic metre volume table for lodgepole pine (all ages), Yukon Territory, Ecoregions 4 and 12.

DBH (cm)	Height (m)												Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	26	
4		.0038	.0049										5
6			.0111	.0136	.0161	.0185							7
8	.0106			.0242	.0286	.0329	.0371						4
10	.0166						.0580	.0645					4
12	.0239	.0344					.0835	.0929					4
14	.0325	.0469						.1265	.1391				7
16		.0612	.0794					.1653	.1818				6
18			.1005	.1230				.2092	.2301				4
20				.1519	.1791			.2584	.2842				2
22				.1838	.2167				.3439	.3749			2
24				.2188	.2580				.4094	.4462			0
26				.2568	.3028				.4806	.5238			2
28				.2979	.3513				.5574	.6076			3
30				.3420	.4033					.6976	.7547		1
32				.3892	.4590					.7939	.8588		1
34					.5182	.5957	.6721	.7476	.8223	.8963			0
36						.6679	.7536	.8383	.9220				0
38													0
													52

Note: Shading indicates range of data.

Data collected by destructive sampling of 52 trees in accessible locations of the Yukon.
Table shows total volume of entire stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000470 \; D^{2.00235} \; H^{0.90398}$
Standard error of estimate = .0875.
Coefficent of determination (R^2) = .998.

Table 7. Cubic metre volume table for trembling aspen (all ages), Yukon Territory, Ecoregions 2, 4, 5, 9, 11, and 12.

DBH (cm)	Height (m)												Basis (No. of Trees)
	4	6	8	10	12	14	16	18	20	22	24	26	
4			.0048	.0060	.0073								18
6	.0050				.0157	.0184							16
8	.0065					.0317	.0365						18
10	.0130	.0199					.0556	.0630					19
12		.0281	.0380				.0785	.0889					16
14		.0376	.0508					.1189	.1328				18
16		.0484	.0654					.1531	.1709				19
18		.0604	.0817						.2135	.2360			13
20		.0738	.0997						.2606	.2880			11
22			.1194							.3448	.3777		5
24			.1407	.1778						.4064	.4453		5
26				.2069						.4728	.5180		4
28				.2380	.2881					.5439	.5959		4
30				.2711	.3282					.6197	.6788		4
32					.3708	.4358				.7000	.7669		2
34					.4158	.4887				.7850	.8600		2
36					.4632	.5445				.8746	.9581		1
38						.6031	.6937	.7849	.8765	.9687			0
40							.7643	.8648	.9658				0
													175

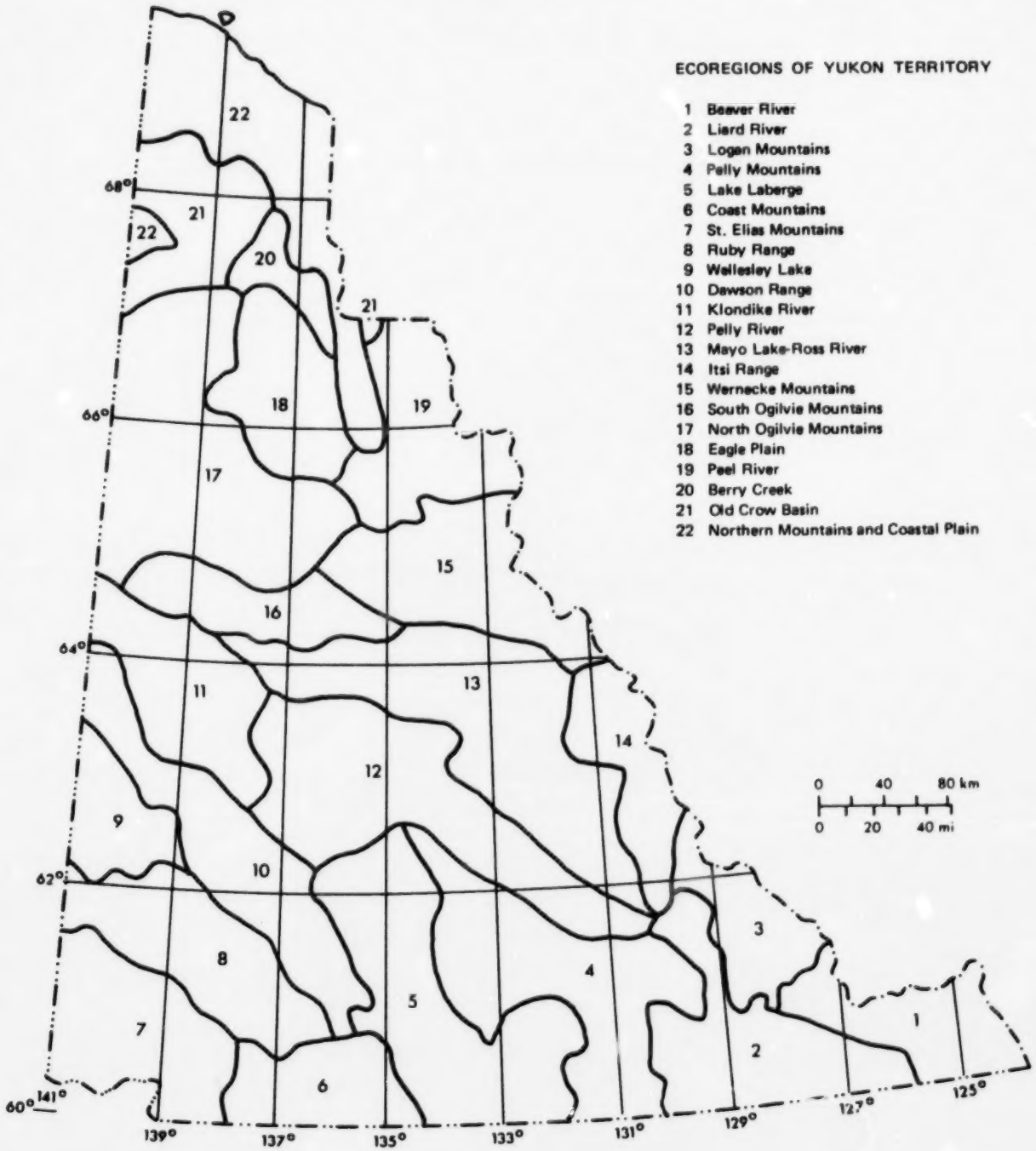
Note: Shading indicates range of data.

Data collected by destructive sampling of 175 trees in accessible locations of the Yukon.
Table shows total volume of entire stem, inside bark. The DBH shown is outside bark (field measurement).
The height shown is total tree height. There is no allowance for defect.
Table volumes obtained by means of logarithmic equation derived by the least squares method.
Equation: $\text{Volume} = .0000392 \; D^{1.88989} \; H^{1.04839}$
Standard error of estimate = .0943.
Coefficient of determination (R^2) = .996.

APPENDIX A

Ecoregion	Number of Samples			
	White Spruce	Black Spruce	Lodgepole Pine	Trembling Aspen
1	68	------	------	------
2	48	42	54	34
4	40	34	29	28
5	35	32	43	30
8	41	40	------	------
9	30	53	------	20
11	47	47	------	23
12	53	52	23	40
Total	362	300	149	175

APPENDIX B



From: Oswald and Senyk (1977)

APPENDIX C

Covariance Analysis: White Spruce

Source	Analysis of Covariance Sum of Squares	Degrees of Freedom (df)
Deviations from common line	6.15689	358
Deviations from group lines	4.59283	355
Due to differences between group lines	1.56406	3
	Residual Sum of Squares	
Ecoregion–(1, 2, 9, 11, 12)	3.52802	242
–(4, 5, 8)	1.06481	113
All regions	6.15689	358

H_A: Common Line

$$F = \frac{1.56406/3}{4.59283/355} = \frac{0.5214}{0.0129} = 40.4186 \ (3, 355 \text{ df})$$

F significant at 1% level, i.e., group lines better than common line

Appendix C (continued)

Covariance Analysis: Black Spruce

Source	Analysis of Covariance Sum of Squares	Degrees of Freedom (df)
Deviations from common line	2.33066	297
Deviations from group lines	2.00660	294
Due to differences between group lines	0.32406	3
	Residual Sum of Squares	
Ecoregion–(2, 5, 11, 12)	1.34179	170
–(4, 8, 9)	0.66481	124
All regions	2.33066	297

H_A: Common Line

$$F = \frac{0.3241/3}{2.0066/294} = \frac{0.1080}{0.0068} = 15.8824 \text{ (3, 294 df)}$$

F significant at 1% level, i.e., group lines better than common line

Appendix C (continued)

Covariance Analysis: Lodgepole Pine

Source	Analysis of Covariance Sum of Squares	Degrees of Freedom (df)
Deviations from common line	1.96584	144
Deviations from group lines	1.80652	141
Due to differences between group lines	0.15932	3
	Residual Sum of Squares	
Ecoregion–(2, 5)	1.43350	93
–(4, 12)	0.37302	48
All regions	1.96584	144

H_A: Common Line

$$F = \frac{0.15932/3}{1.80652/141} = \frac{0.0531}{0.0128} = 4.1484 \text{ (3, 141 df)}$$

F significant at 1% level, i.e., group lines better than common line

POOR

QUALITY

ORIGINAL